

What is claimed is:

1. A thin film photovoltaic cell formed from at least one semiconductor layer, wherein said at least one semiconductor layer includes a copper-indium-gallium-diselenide film having a band gap ranging from 1.1 – 1.45 eV, and said thin film photovoltaic cell has a conversion efficiency of at least 9.0%, an open circuit voltage of at least 0.4 V, a current of at least 30 mA/cm², and a fill factor of at least 58%.
2. A method for preparing a copper-indium-gallium-diselenide film comprising:

providing a substrate;

providing a buffered electro-deposition bath containing ions of copper, indium, gallium, and selenide; and

placing said substrate in said buffered electro-deposition bath to form a semiconductor layer having copper, indium, gallium, and selenide.
3. The method according to claim 2 wherein said substrate is selected from the group consisting of glass, amorphous glass, and soda-lime silica glass.
4. The method according to claim 3 further including applying a molybdenum layer to said substrate.
5. The method according to claim 4 further including adjusting said semiconductor layer composition by physical vapor deposition.
6. The method according to claim 5 wherein adjusting said semiconductor layer composition further includes adding indium by physical vapor deposition.
7. A method for preparing a copper-indium-gallium-diselenide film comprising:

providing a substrate;

providing a buffered electro-deposition bath containing ions of copper, indium, gallium, and selenide;

placing said substrate in said buffered electro-deposition bath to form a semiconductor layer having copper, indium, gallium, and selenide; and

adjusting said semiconductor layer composition by depositing indium by physical vapor deposition.

8. The method according to claim 7 wherein said substrate is selected from the group consisting of glass, amorphous glass, and soda-lime silica glass.

9. The method according to claim 8 further including applying a molybdenum layer to said substrate.

10. A method of fabricating a thin film photovoltaic device, comprising:

(a) providing a substrate;

(b) applying a molybdenum layer to said substrate by radio frequency sputtering;

(c) providing a buffered electro-deposition bath containing ions of copper, indium, gallium, and selenide;

(d) placing said substrate in said buffered electro-deposition bath to form a semiconductor layer having copper, indium, gallium, and selenide;

(e) adjusting said semiconductor layer composition by depositing indium by physical vapor deposition;

(f) depositing a negative-type semiconductor layer by electro-deposition to said semiconductor layer, wherein said negative-type semiconductor layer is comprised of cadmium sulfide;

(g) depositing a first zinc oxide layer by radio frequency sputtering to said negative-type semiconductor layer

(h) depositing an aluminum oxide doped zinc oxide layer by radio frequency sputtering to said first zinc oxide layer;

(i) applying a Nickel/Aluminum electrical contact layer to said aluminum oxide doped zinc oxide layer; and

(j) depositing a anti-reflective coating composed of magnesium fluoride onto said electrical contact layer.

11. The method according to claim 10 wherein said substrate is selected from the group consisting of glass, amorphous glass, and soda-lime silica glass.